LAKE BEECHER

REPORT DESCRIPTION

This report is an update on the health of Lake Beecher based on water quality data collected from 1997 through 2013 by citizen volunteers and Snohomish County Surface Water Management (SWM) staff. For additional background on the information provided here or to find out more about Lake Beecher, please visit www.lakes.surfacewater.info or call SWM at 425-388-3464.

LAKE DESCRIPTION

Lake Beecher is a small, shallow, oxbow lake located about 4 miles south of the City of Snohomish and just west of the Snohomish River. The lake covers 17 acres and has a maximum depth of only 3 meters (9.8 feet). The surrounding watershed, which is the land area that drains to the lake, is very large (over 260 times the size of the lake). Development within the watershed continues to increase, with more homes and businesses every year.

LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (shown in red) for water clarity and total phosphorus for Lake Beecher. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

Water Clarity

The water clarity of a lake, measured with a Secchi disk, is a reading of how far one can see into the water. Water clarity is affected by the amount of algae and sediment in the lake, as well as by water color. Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

Water clarity in Lake Beecher is low because of algae growth and the slight color of the water. The long-term average water clarity is 1.2 meters (3.9 feet), with little year to year variability. This is partly because the maximum lake depth is only 3 meters. Water clarity in 2013 averaged 1.6 meters, somewhat better than the long-term average. Overall, there has been a tiny, but statistically significant, trend toward improved water clarity in Lake Beecher (p=0.01).
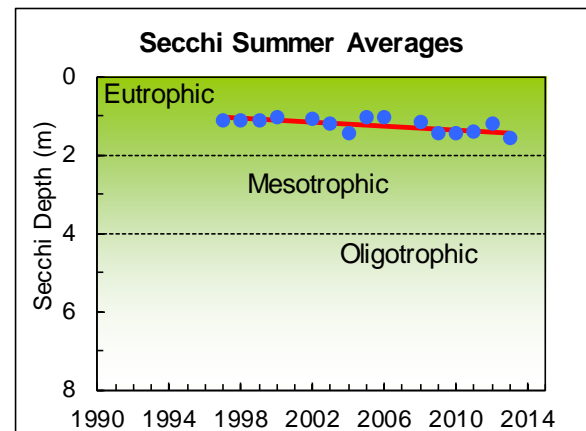
Water Color

The color of lake water affects water clarity and the depths at which algae and plants can grow. In many lakes, the water is naturally brown, orange, or yellow. This darker color comes from dissolved humic compounds from surrounding wetlands and does not harm water quality. Measurements of true water color provide clues to changes in water clarity. True water color is only the color from dissolved materials and not of the color of algae or sediment suspended in the water.

The true water color of Lake Beecher averaged 18 pcu (platinum-cobalt color units) in 2010 - 2011, which indicates a slight to moderate amount of color in the lake. This amount of color could have a small effect on the amount of algae that grows in the lake. No previous water color measurements have been taken at Lake Beecher to see if the water color has changed over time.

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## *Phosphorus (key nutrient for algae)*

Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients include fertilizers, pet and animal wastes, poorly-maintained septic systems and erosion from land clearing and construction. Monitoring of phosphorus levels over time helps to identify changes in nutrient pollution.

Total phosphorus concentrations in the epilimnion (upper waters) are high (in the eutrophic range) and quite variable. For this reason, Lake Beecher is listed as "impaired" in Washington State's official 2012 water quality assessment.

The long-term 2002 to 2013 total phosphorus summer average is 68 µg/L (micrograms per liter, which is equivalent to parts per billion) in the upper waters. Individual phosphorus measurements have varied considerably in past years, from as low as 27 µg/L in 2004 to a high of 234 µg/L in 2003. Overall, there has been a statistically significant trend toward lower phosphorus levels (p=0.04), which is especially evident in recent years. The high phosphorus values in the epilimnion are a result of nutrients washing in from the large watershed surrounding Lake Beecher and from the periodic Snohomish River floods that inundate the lake. It has been a number of years since large river flooding has fully inundated Lake Beecher, so declining phosphorus levels may be partly the result of stabilizing conditions in the lake. Weather patterns can also contribute to the variability in phosphorus because there may be more or less mixing between the upper waters and nutrient-rich bottom waters from year to year.
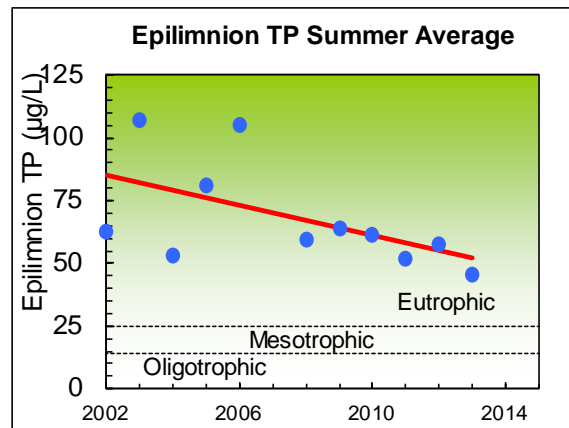
Total phosphorus averages in the hypolimnion (bottom waters) are also high, with a long-term 2002 - 2013 summer average of 96 µg/L. Besides an abnormally high average in 2006 (220 µg/L), the phosphorus concentrations in the lower waters appear to be declining. In fact, there has been a small, but statistically significant, trend toward lower phosphorus levels (p=0.06). This may indicate improvements in water quality, but may also be a sign of mixing between lake water layers and/or stabilizing conditions from past river inundations in this oxbow lake.
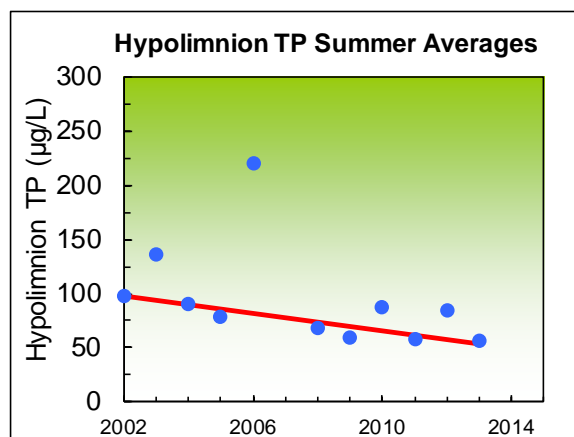
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Chlorophyll a (Algae)

Algae are tiny plant-like organisms that are essential for a healthy lake. Fish and other lake life depend on algae as the basis for their food supply. However, excessive growths of algae, called algae blooms, can cloud the water, form unsightly scums, and sometimes release toxins. Excess nutrients, such as phosphorus, are the main cause of nuisance algae growth in a lake. Chlorophyll *a* measurements are one method for tracking the amount of algae in a lake.

There are no chlorophyll *a* measurements for Lake Beecher. However, SWM staff and volunteers have observed regular algae blooms in the lake. A significant bloom of cyanobacteria, or blue-green algae, was documented in Lake Beecher in July and August of 2008. Blooms were also observed intermittently in the summer of 2009. During a bloom, the water turns bright green or blue, and the algae may look like paint floating on the water's surface. This type of bloom has the potential to be toxic and could cause serious illness in humans who drink or play in the affected waters. Therefore, lake users should avoid contact with the water and keep pets away from the lake when it is experiencing a blue-green algae bloom.

SUMMARY

Trophic State

All lakes go through a process of enrichment by nutrients and sediment. In this process, known as eutrophication, nutrients and sediment contribute to the ever-increasing growth of algae and aquatic plants. Over thousands of years, lakes will gradually fill up with organic matter and sediments.

Lakes can be classified by their degree of eutrophication, also known as their trophic state. There are three primary trophic states for lakes—oligotrophic, mesotrophic, and eutrophic—as well as intermediate states. Oligotrophic lakes are usually deep, with clear water, low nutrient concentrations, and few aquatic plants and algae. Mesotrophic lakes are richer in nutrients and produce more algae and aquatic plants. Eutrophic lakes are often shallow and characterized by abundant algae and plants, high nutrient concentrations, limited water clarity, and low dissolved oxygen in the bottom waters.

The trophic state classification of a lake does not necessarily indicate good or bad water quality because eutrophication is a natural process. However, human activities that contribute sediment and excess nutrients to a lake can dramatically accelerate the eutrophication process and result in declining water quality.

Based on the long-term monitoring data, Lake Beecher may be classified as eutrophic because of low water clarity and high phosphorus concentrations. The lake is highly productive for both plants and algae. The eutrophic condition is likely the natural state for a shallow oxbow lake.

Condition and Trends

The water quality targets for Lake Beecher are to maintain stable water clarity and to avoid any increases in phosphorus levels. Water clarity has shown a small, but statistically significant, trend toward improvement, so this meets the target. Total phosphorus levels have also shown statistically significant decreasing trends in both the epilimnion and the hypolimnion. However, phosphorus levels are still higher than the criterion set by Washington State for lakes in the Puget Sound basin.

Overall, Lake Beecher is at risk of declining water quality because of potential impacts from development in its very large watershed. Land clearing and development increase the amount of nutrients that wash into the lake during rain events. To find out more about ways to protect lake water quality and for information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LAKE BEECHER				
		Water Clarity (Secchi depth in meters)	**Total Phosphorus (ug/L)**	
Source	**Date**		**Surface**	**Bottom**
Sumioka and Dion,1985	**7/6/81**	1.2	60	90
SWM Staff or Volunteer	**1997**	1.0 - 1.3 (1.1) n = 10	126*	58*
Volunteer	**1998**	1.0 - 1.4 (1.1) n = 4	-	-
Volunteer	**1999**	1.1	-	-
Volunteer	**2000**	0.8 - 1.3 (1.0) n = 3	-	-
SWM Staff or Volunteer	**2002**	0.8 - 1.3 (1.1) n = 4	46 - 71 (62) n = 4	67 - 127 (98) n = 4
Volunteer	**2003**	1.1 - 1.3 (1.2) n = 4	49 - 234 (107) n = 4	50 - 266 (136) n = 4
Volunteer	**2004**	1.2 - 1.8 (1.4) n = 3	27 - 90 (53) n = 3	40 - 151 (90) n = 3
Volunteer	**2005**	0.8 - 1.3 (1.1) n = 2	73 - 89 (81) n = 2	79
Volunteer	**2006**	1.0 - 1.1 (1.1) n = 2	53 - 156 (105) n = 2	189 - 250 (220) n = 2
SWM Staff or Volunteer	**2008**	1.0 - 1.7 (1.2) n = 9	42 - 74 (59) n = 3	60 - 77 (69) n = 2
SWM Staff or Volunteer	**2009**	1.3 - 1.7 (1.4) n = 8	34 - 111 (64) n = 4	47 - 70 (60) n = 4
SWM Staff or Volunteer	**2010**	1.1 - 1.9 (1.5) n = 12	52 - 77 (61) n = 4	53 - 153 (88) n = 3
SWM Staff or Volunteer	**2011**	1.0 - 2.0 (1.4) n = 12	47 - 53 (52) n = 4	49 - 63 (57) n = 4

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DATA SUMMARY FOR LAKE BEECHER				
Source	**Date**	**Water Clarity (Secchi depth in meters)**	**Total Phosphorus (*u*g/L)**	
			Surface	**Bottom**
SWM Staff or Volunteer	**2012**	0.9 - 1.5 (1.2) *n = 12*	44 - 66 (58) *n = 4*	76 - 100 (84) *n = 4*
SWM Staff or Volunteer	**2013**	1.1 – 2.1 (1.6) *n = 13*	42 - 48 (45) *n = 4*	50 - 64 (56) *n = 4*
Long Term Avg		**1.2 (1997-2013)**	**68 (2002-2013)**	**96 (2002-2013)**
TRENDS		**Increasing**	**Decreasing**	**Decreasing**

NOTES
- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (n).
- Total phosphorus data are from samples taken at discrete depths only.
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.

* *Data not included in long-term trends - flood occurred just prior to sampling inverting lake stratification.*